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CIRCUIT COMPRISING AN INTEGRATED SWITCHING CIRCUIT AND A VOLTAGE REGULATING CIRCUIT

BACKGROUND OF THE INVENTION

This invention relates to the field of integrated circuits, and in particular to an integrated circuits that include an integrated switching circuit and a voltage regulating circuit, which furnishes a regulated voltage for the operation of the circuit.

Circuits are constructed from electrical and/or electronic components as well as integrated circuits on an insulating board. The connections between the components and circuits are made via conductor paths. The energy necessary for the operation of the circuit is fed in the form of a supply voltage. For proper functioning of the circuit, the value of the supply voltage must lie in a certain range. If an available voltage is unsuitable as a supply voltage because of large voltage fluctuations, a constant supply voltage can be obtained by using a voltage regulating circuit.

Voltage regulating circuits are discrete components that receive an input voltage that can lie in a certain range, and deliver a nearly constant output voltage largely independently of the load on the output of the voltage regulating circuit. The voltage regulating circuit generates, for example from the available fluctuating input voltage, the constant supply voltage that is required for the proper operation of the circuit. The voltage regulating circuit is mounted on the board along with the other discrete components and the integrated circuits.

An example of such a circuit is an ISDN adapter for a personal computer with a universal interface (e.g., USB interface), which can be obtained under the designation "Siemens I-Serve USB." The adapter includes a board, which includes a voltage regulating circuit along with some integrated circuits and discrete components, some of which are surface-mounted devices (SMD). The voltage regulating circuit in turn includes a plurality of components and circuits and forms its own functional

unit. It is connected to the other components via conductor paths. Via the serial bus, for example, the voltage regulating circuit includes the voltage to be regulated. A problem with such a design is the relatively large amount of space required on the board to mount the various individual components.

SUMMARY OF THE INVENTION

An integrated circuit comprises a switching circuit and a voltage regulating circuit, wherein the voltage regulating circuit provides a regulated voltage to the switching circuit.

In one embodiment, the regulated voltage is provided on an internal connection between the switching circuit and the voltage regulating circuit. The internal connection is also integrated on the substrate material, along with the switching circuit and the voltage regulating circuit. The integrated circuit may also include an external contact on which the voltage regulating circuit provides the regulated voltage. As a result, the regulated voltage may also be provided to the integrated switching circuit via the internal connection, and the regulated voltage is also provided to circuitry located outside of the integrated circuit via the external contact.

In another embodiment, the voltage regulating circuit provides the regulated voltage to the integrated switching circuit via connections that are outside the integrated circuit. There is no internal connection between the voltage regulating circuit and the switching circuit for providing the regulating voltage. The supply voltage is fed to the switching circuit from outside.

In yet another embodiment, the voltage regulating circuit provides the regulated voltage to a switching circuit that also receives an external voltage signal provided by an voltage source external to the integrated circuit. The switching circuit selectively applies either the regulated voltage or the external voltage signal to the integrated switching circuit via an integrated circuit input contact.

These and other objects, features and advantages of the present invention will become more apparent in light of the following detailed description of preferred embodiments thereof, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 illustrates a first embodiment of an integrated circuit with an integrated switching circuit and a voltage regulating circuit;

FIG. 2 illustrates a second embodiment of an integrated circuit with an integrated switching circuit and a voltage regulating circuit;

FIG. 3 illustrates a third embodiment of an integrated circuit with an integrated switching circuit and a voltage regulating circuit; and

FIG. 4 illustrates a fourth embodiment of an integrated circuit with an integrated switching circuit and a voltage regulating circuit.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 illustrates an circuit 100 that includes an integrated switching circuit 1 and a voltage regulating circuit 2. A data bus 3 connects the circuit to a main device 4, which is, for example, a computer (PC) that is upgraded with a function that is implemented by the switching circuit 1.

The main device 4 supplies the circuit 100 with a supply voltage V having a first potential VDD and a second potential VSS, via the data bus 3. In addition, the main device 4 and the circuit 100 exchange data D-, D+ via the data bus 3.

In order to obtain a constant supply voltage, the supply voltage V delivered via the data bus 3 from the main device 4 is input to the voltage regulating circuit 2. The voltage regulating circuit 2

generates a regulated supply voltage VG, which is largely constant even in case of fluctuations of the supply voltage VDD, VSS. Regulation of the supply voltage is necessary, as a rule, if the supply voltage V delivered from the main device 4 is subject to fluctuations that are too large for the proper operation of the circuit 100.

Both the switching circuit 1 and the voltage regulating circuit 2 are integrated on a substrate material. Suitable as the substrate material is, for example, a semiconductor substrate, on which all components of the switching circuit 1 and of the voltage regulating circuit 2 are implemented and connected into the desired circuits in a unified technological process. The components can also be mounted on a glass or ceramic substrate. The integrated switching circuit 1 and the voltage regulating circuit 2 form a unit and are mounted, for example, in a package.

There can be an electrical connection between the switching circuit 1 and the voltage regulator 2. However, the switching circuit 1 and the voltage regulator 2 can also be electrically isolated from each other. Any contacts and outputs of the switching circuit 1 that may be present are not shown in FIG. 1.

Referring to FIG. 1, the voltage regulating circuit 2 provides the regulated supply voltage VG to the switching circuit 1 via an internal connection 5. The regulated supply voltage VG of the voltage regulating circuit 2 is furnished to the switching circuit 1 via this internal connection 5 as the voltage necessary for the operation of the switching circuit 1. The internal connection 5 thus makes an electrical connection between the circuits 1 and 2.

The internal connection 5 is again present in the embodiment illustrated in FIG. 2. The embodiment illustrated in FIG. 2 is substantially the same as the embodiment illustrated in FIG. 1, with the principal exception that the voltage regulator 2 illustrated in FIG. 2 includes a voltage contact 6 at which the regulated supply voltage VG can be taken off. The voltage contact 6 is led out

of the substrate material of the voltage regulator 2. The voltage contact 6 is accessible outside the circuit even if the circuit is mounted in a package.

An additional device 7, for the operation of which a regulated supply voltage VG is likewise required, can be connected via the voltage contact 6. In this case, the voltage regulating circuit 2 supplies both the switching circuit 1 and also an additional device 7 with the regulated supply voltage VG.

The additional device 7 is not integrated on the substrate material. It is a free-standing device that can be operated without the circuit.

FIG. 3 illustrates a third embodiment of an integrated circuit 300 with an integrated switching circuit 301 and an voltage regulating circuit 302. In this embodiment, there is no internal connection between the voltage regulating circuit 302 and switching circuit 301. Insulation 8 electrically isolates the switching circuit 301 from the voltage regulating circuit 302. The regulated supply voltage VG is not fed to the switching circuit 301 within the circuit. The switching circuit 301 is supplied via an external linking line 9, which is connected to voltage contact 306. Because of the insulation 8, the regulated supply voltage of the voltage regulating circuit 302 can be taken off only via the voltage contact. The voltage contact can be built up from a plurality of contacts. The external linking line 9 is connected to supply contacts 10 as well as to the voltage contact 306. The supply contacts 10 are electrically connected to the switching circuit 301. The switching circuit 301 is supplied with the voltage necessary for operation via the supply contacts.

The insulation 8 must be such that the regulated supply voltage VG does not affect the switching circuit 301 if no linking line 9 is connected to the voltage contact 6. Exchange of charge carriers between the switching circuit 301 and voltage regulating circuit 302 can nevertheless be possible.

Along with the external linking line 9, the additional device 7 can also be connected to the voltage contact 6, as it is in the embodiment illustrated in FIG. 2. The voltage regulating circuit 302 then supplies both the additional device 7 and the switching circuit 301 with regulated supply voltage VG via the external linking line 9 and the supply contacts 10. The supply voltage VDD, VSS is delivered from the main device 4 to the voltage regulating circuit 302 via the data bus 3. Data exchange between the main device 4 and the switching circuit 301 also takes place via the data bus 3.

FIG. 4 illustrates a fourth embodiment of an integrated circuit 400 with an integrated switching circuit 401 and an voltage regulating circuit 402. In this embodiment, the switching circuit 401 is also electrically isolated by insulation 8 from the voltage regulating circuit 402. However, as illustrated in FIG. 4 voltage contact 406 is connected to the external linking line 9 not directly, but rather via a first switch 11. If the first switch 11 is closed, a connection is made between the voltage contact 406 and the supply contacts 10. Again, there can be additional device 7, which is connected to the external linking line 9 in such a way that it is supplied with the regulated supply voltage VG when the first switch 11 is closed.

The external linking line 9 is connected to an external voltage source 13 via a second switch 12. The two switches 11, 12 are designed in such a way that only one of the switches can be closed at any time. If the first switch 11 is opened, the second switch 12 is closed. If the second switch 12 is opened, the first switch 11 is closed. This switching condition can be imposed, for example, by an appropriate mechanical device or a suitable electronic control.

Referring still to FIG. 4, the switching circuit 401 and the additional device 7, if present, can be supplied from the voltage regulating circuit 402 or the external voltage source 13, as selected. The external voltage source 13 likewise generates the regulated supply voltage VG. The external voltage source 13 is not integrated on the substrate material and is connected to the external linking

line 9, for example via a connecting line.

The supply via the external voltage source 13 can be present, for example, if the power furnished via the data bus 3 is not sufficient for the operation of the switching circuit 401. The switching circuit 401 can be operated even in case of a defect in the voltage regulating circuit 402.

The circuit can be embodied, in particular, with a switching circuit for telecommunications purposes, for example ISDN (Integrated Services Digital Network) adapter.

Although the present invention has been shown and described with respect to several preferred embodiments thereof, various changes, omissions and additions to the form and detail thereof, may be made therein, without departing from the spirit and scope of the invention.

What is claimed is: